

RP2D Series Remote I/O User Manual

V2.1



Revision history

Date	Version
2010.04.08	V1.0 published
2011.02.10	V2.0 published
2011.02.16	V2.1 published

Safety precautions

Please read this manual and the related data which mentioned in this manual carefully before using the product. Make sure the safety of proper operation. The instructions given in this manual are all about the product.

Icons defined:



Warning

Avoid operational risk



Be careful

Be careful when operating
and installing



Nonprofessionals

forbid operating



- Before installation and wiring, make sure the power supply of the system be cut off, or it may result in electric block and the damage of the product
- Keep any foreign matters (metal broken foil and wiring fragments .e.g.) from the model internal, these foreign matters may cause fire fault
- Make sure the Communication cables and power cables are laid in the cable trough or are clamped



- The operating environment should satisfy the condition that mentioned in the user manual, or it may cause shock, fire, fault, and might damage the product, make the product can't reach the expected effect etc.
- Install the module properly, or it may cause fault, failure or falling of the module
- Before installing and removing the module, make sure the internal power supply is cut off, or it may damage the module.
- Don't touch the conductive part or electronic components directly, it may cause the fault or failure of the module



- Before installing and removing the module, make sure the internal power supply is cut off, or it may damage the module or cause fault
- Don't touch the terminals when the power is on, or it may damage the module or cause fault. Please make sure the power is cut off before tightening the terminal screws or clearing the module and retightening the terminal screws.

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1 Instructions

1.1 An overview of the CANopen remote I/O

Remote I/O is a kind of I/O system that provides fieldbus interface, it composed of various extension modules and bus interface modules, the protection grade is IP20, and it can be installed in the distribution cabinets or at the site for use.

RP2 series CANopen I/O can communicate with other CANopen devices, and it accords with the CIA 301 and CIA 302 protocol standards.

This module is suitable for I/O extension application of HMI, PLC which has CANopen function, for example machine control in factory automation field and small-scale process control. This module can satisfy the demands of the following application fields (But not limited to these applications):

Packing machinery	Textile machinery	Building materials machinery
Food machinery	Plastic machinery	CNC machine
Printing machinery	Central air conditioning	Environmental protection equipment
Single process control devices		

1.2 Standards and specifications about the product

Standard	Scope
IEC60529 Shell protection class	protection class of the product
IEC 61131-2: Programmable controllers – Part 2: Equipment requirements and tests	All the products
RoHS : the Restriction of the use of certain hazardous substances in electrical and electronic equipment	Material of the product
CIA DS401: Device Profile for Generic I/O Modules	CANOpen
CIA DS301 : Electronic data sheet specification for CANOpen	

1.3Product Category distinguish

The “product name “of the Kinco remote I/O module is used to express the main functions and use of the product .The product name is not unique,it is a generic terms of one kind of products

“The product name” can be defined according to the following principles:

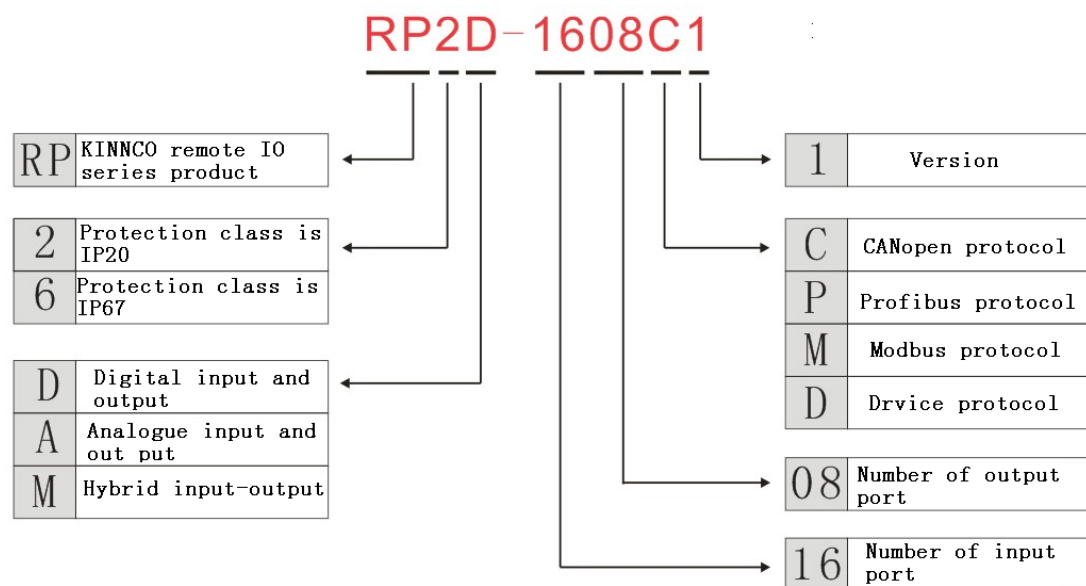


Chart 1 Name principles of RP2D

1.4 Product list of Kinco RP2 series remote I/O products

Type	Name	Descriptions of function
Digital IO module	RP2D-1608C1	DC 24V power supply,DI 16×DC24V, DO 8×DC24V DO is Transistor output,rated output current for each channel is 0.5 A
	RP2D-0016C1	DC 24V power supply,DO 16×DC24V DO is Transistor output,rated output current for each channel is 0.5 A

Form 1 Product list of RP2D series

2 Technical characteristics

2.1 The characteristics of the CANopen

- Communication norm accord with CiA 301 V4.02
- Device norm accord with CiA 401 V2.1
- status indication norm accord with CiA 303-3 V1.0
- 2 TPDO and 2 RPDO
- SDO-Server
- Life guarding, Node guarding, Heartbeat Producer
- Emergency Producer
- Minimum start capacity(slave)

2.2 The configuration of Communication and device

- The CAN bus driver is Non-Current coupling.It can support 100 CAN nodes at one bus at most
- Set the node ID and baud rate by hardware switches
- The Bit Rate of the CAN bus: from 10kBit/s to 1Mbit/s
- High quality interface (lockable)
- When the error occurred it can send Emergency Messages

2.3 Power, environment conditions and shell

- Working voltage: 24V $\pm 10\%$;
- Current consumption: 70mA
- Working temperature: -20 $^{\circ}\text{C}$ to +65 $^{\circ}\text{C}$
- Storage temperature: -20 $^{\circ}\text{C}$ to +90 $^{\circ}\text{C}$
- Dimention: (LxWxH in mm): $139.2 \times 86.4 \times 51$
- Weight: about 130g

3 The connection Settings of CAN bus module

3.1 Node ID settings

1) Use the red dial switches (bit1-bit7) to set the station number, the node ID can not be the same in a same CANopen network ,its range is from 1 to 127.

DIP1 Bit0	DIP2 Bit1	DIP3 Bit2	DIP4 Bit3	DIP5 Bit4	DIP6 Bit5	DIP7 Bit6	Node ID
ON	OFF	OFF	OFF	OFF	OFF	OFF	1
OFF	ON	OFF	OFF	OFF	OFF	OFF	2
ON	ON	OFF	OFF	OFF	OFF	OFF	3
OFF	ON	ON	ON	ON	ON	ON	126
ON	ON	ON	ON	ON	ON	ON	127

Form 2 The code table of node ID

3.2 The baud rate

Use the red dial switches (bit8-bit10) to set communication speed, the module's communication speed must be the same in a same CANopen network

DIP8 Bit0	DIP9 Bit1	DIP10 Bit2	Baud rate
OFF	OFF	OFF	10K
ON	OFF	OFF	20K
OFF	ON	OFF	50K
ON	ON	OFF	125K
OFF	OFF	ON	250K
ON	OFF	ON	500K
OFF	ON	ON	800K
ON	ON	ON	1M

Form 3 The code table of the baud rate

Note: Cut off the power and restart the I/O module after you've set the node ID and commutation speed

3.3 Terminal resistances

There is no terminal resistances inside the module, so you should set a 120 ohms terminal resistances at the two sides of the network when you use it.

3.4 Connection of CAN bus

The PIN name of the commutation bus terminal

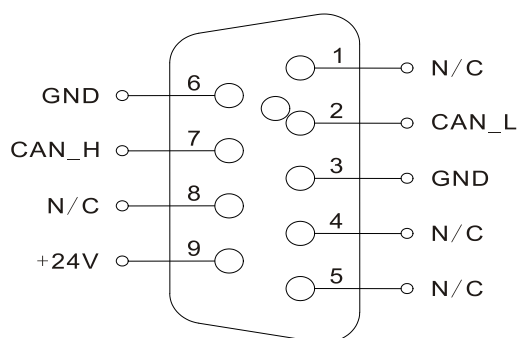


Figure 2 The PIN of commutation bus terminal

Descriptions of each pin's function

Serial number	name	descriptions
1	N/C	NC
2	CAN_L	Differential Signal of CAN
3	GND	Low level power for CAN
4	N/C	NC
5	N/C	NC
6	GND	Low level power for CAN
7	CAN_H	Differential Signal of CAN
8	N/C	NC
9	+24V	+24V power for CAN

Form 4 Description of the CAN bus terminal's pins

Note: It must be connected to external 24V power supply when it works

3.5 Service Data Objects (SDO)

We use SDO to visit the Object Dictionary of a device, Visitors are called client. The CANOpen device, which the Object Dictionary is visited by and provide request service, is called server. The client's CAN message and server's response CAN message always includes 8 bytes data (Though not all the data byte is significative). A client request must have response from server.

In the CANopen protocol, we can use SDO to change the content of the Object Dictionary, Following is the structure of the SDO command and standards that it follows :

The basic structure of SDO: Client→Server/Server→Client

Byte0	Byte1-2	Byte3	Byte4-7
SDO Command specifier	Index of Object	Sub-index of Object	**

(** four bytes of data at most)

Form 5 The basic structure of the SDO

SDO command word contains the following information:

Download / upload

Request /response

Segmented / expedited transfer

The length of CAN frame data byte ,it is used for toggle bit of every segment.

SDO achieve five request/response protocols

(1) Initiate Domain Download ;(2) Download Domain Segment ;(3) Initiate Domain Upload ;(4) Upload Domain Segment;(5) Abort Domain Transfer;

§ Download means the writing operations to the Object Dictionary; Upload means the reading operations to the Object Dictionary.

§The grammar and details of SDO command word (the first byte in the SDO CAN message) is explained as following: (‘—’means unrelated ,it should be 0)

§when reading the parameters, use the protocol of Initiate Domain Upload

§when setting the parameters, use the protocol of Initiate Domain Download

Initiate Domain Download								
Bit	7	6	5	4	3	2	1	0
Client→	0	0	1	-	n		e	s
←Server	0	0	1	-	-	-	-	-

Description:

n: means the byte number of insignificant data in the message [The data from the (8-n) byte to the 7th byte data are insignificant](n is effective when e =1 and s=1,or n=0).

e: Transmit normally when e=1, transmit speedy when e=0

s: whether the length of the data is indicated, when s=0 it means the data length is not indicated ,s=1 means the data length is indicated

e=0, s=0: it is reversed by CiA

e=0, s=1: data byte is byte calculator, byte 4 is the Least Significant Bit (LSB),byte 7 is the most Significant Bit(MSB)

e=1:The data byte is the data that will be downloaded

(Initiate Domain Download)								
Bit	7	6	5	4	3	2	1	0
Client→	0	0	1	-	-	-	-	-
←Server	0	0	1	-	n		e	s

Examples:

※ Read the parameters

send SDO messages

Identifier	DLC	Daten							
		0	1	2	3	4	5	6	7
0x600+Node_ID	8	Send command word	Index of Object		Subindex of object	00			

Receive SDO message

Identifier	DLC	Daten							
		0	1	2	3	4	5	6	7
0x580+Node_ID	8	Send command word	Index of Object		Subindex of object	**			

(** four bytes of data at most)

※ Note: All the command word is 0x4 when SOD sends the message

If data is one byte, then the receiving command word is 0x4F

If data is two bytes, then the receiving command word is 0x4B

If data is three bytes, then the receiving command word is 0x43

※ When modify the parameters

Send the SDO message

Identifier	DLC	Daten							
		0	1	2	3	4	5	6	7
0x600+Node_ID	8	Send command word	Index of Object		Sub-index of object	**			

(“**”) four bytes of data at most)

Receive the SOD message

Identifier	DLC	Daten							
		0	1	2	3	4	5	6	7
0x580+Node_ID	8	Send command word	Index of Object		Sub-index of object	**			

※ Note: All the command word is 0x60 when SOD receives the message

If data is one byte, then the sending command word is 0x2F

If data is two bytes, then the sending command word is 0x2B

If data is three bytes, then the sending command word is 0x23

3.6 Process data object (PDO)

PDO is used to transmits process data among nodes, such as reading and setting I/O state of I/O module, collection and output of analogue and so on.. Considering the slaver limit, this protocol supports 4 groups of PDO, each group include a RPDO and a TPDO, we take RP2D-1608C1 I/O module for example to give some explains:

Assuming the I/O module has 16 input points and 8 output points, the 16 inputs are transmitted to the monitor terminal or other nodes via TPDO, the 8 outputs are set by controlling terminal via RPDO.

0x180+NODE_ID, RPDO: 0x200+NODE_ID, two bytes are enough used to express the value of 16 I/O, so sending and receiving PDO can be expressed as belows: (assume NODE_ID=1):

1. I/O node → monitor terminal (TPDO)

COB-ID	0 byte	1 byte
0x181	Data: input the I/O state variable	
	Input_Digital1	Input_Digital2

2. I/O node ← monitor terminal (RPDO)

COB-ID	0 字节	1 字节
0x201	Data: output the I/O state variable	
	Output_Digital1	Output_Digital2

3.7 NMT module control

Only NMT-Master nodes can transmit NMT Module Control message. All the slave devices must support the NMT module control service.

The message needn't respond in NMT Module Control. The format of the NMT message is as follows:

NMT-Master → NMT-Slave(s)

COB-ID	Byte0	Byte1
--------	-------	-------

0x000	CS	Node-ID
-------	----	---------

Table 6 format of the NMT message

When Node-ID=0, all the slave devices of NMT are addressed, CS is command word, it can take values as below:

CS	NMT service
0x01	Start Remote Node
0x02	Stop Remote Node
0x80	Enter Pre-operational State
0x81	Reset Node
0x82	Reset Communication

Table 7 the range of CS command word

3.8 Protection of NMT nodes

By the means of nodes protection service, the NMT master-node can check each node's current state, This service is especially meaningful when these nodes have no data to transmit.

The NMT-Master nodes send remote frame(no data) as follows:

NMT-Master → NMT-Slave

COB-ID
0x700+Node_ID

The NMT-slave nodes send followings message to response:

NMT-Master ← NMT-Slave

COB-ID	Byte0
0x700 + Node_ID	Bit 7 : toggle Bit6-0 : States

The data part includes a trigger bit which must be set 0 or 1 alternately in each node protection.

The trigger bit is set "0" in the first request of node protection. Bite 0~bite 6 means the state of nodes, they can take values in following form:

State code	Meanings of status code
0x00	Initializing
0x01	Disconnected *
0x02	Connecting *
0x03	Preparing *
0x04	Stopped
0x05	Operational
0x7F	Pre-operational

Form 8 description of the NMT node message

Note: Only the nodes that support the expanding boot-up can provide the state with "*". Notice that state 0 never appear in the node protection response, because nodes don't response node protection message under this state. Or a node can be configured to produce periodic message called Heartbeat message

Suppose NODE_ID=2

node→monitor terminal

COB-ID	0 byte
0x702	State of node
	0x00

Then return the state is as follows:

State node	Meanings of states code
0x00	Boot-up
0x04	Stopped
0x05	Operational
0x7F	Pre-operational

When a Heartbeat node start ,its Boot-up message is its first Heartbeat message . Heartbeat costumer usually is NMT-Master node who sets a timeout for each Heartbeat, and it take corresponding actions when time is out

A node can not support Node guarding or Heartbeat protocol at the same time.

3.9 The Emergency

When hardware or software errors are detected by nodes in the network, they can notify other nodes though the emergency, any internal error will be encoded into error code that defined and then transmitted to other nodes, if the errors are all corrected, then node will send a message with “no error”

The emergency of CANopen contain the following types of error:

- Communication error:
 - ✓ Frequent error when transmitting message
 - ✓ Error that the CAN controller is broken away from the bus
 - ✓ Overflow of sending buffer
 - ✓ Overflow of receiving buffer
 - ✓ Missing of message of Heartbeat or Life-guarding
 - ✓ CRC error when transmit in the SDO module

- Application error

Application error refers to short-circuit, underpressure, beyond the temperature limit, code or RAM error, etc

Emergency message contains 8 bytes, the first and second bytes contains information that defined in the device specification, the third byte contains content of the error buffer, the remaining 5 bytes contains error information that defined by the device manufacture. Error information code of emergency state is stored at 1003h of Object dictionary index , errors will be written in the index according to time. The oldest error will occupy the highest position of sub index

The format of emergency object message is as follows:

Byte	0	1	2	3	4	5	6	7
content	Code error		Error register object	Error area the manufacturer defined				

This module will support the error code as follows:

Error code	Description of error code
0x0000	Reset error or no error
0x1000	General error
0x3110	Input voltage is too high
0x3120	Input voltage is too low
0x3210	Internal voltage is too high
0x3220	Internal voltage is too low
0x5000	Errors of device hardware
0x6100	Errors of internal software of device
0x8110	CAN Overrun

0x8120	Error Passive
0x8130	Life guard or Heartbeat error
0x8140	Recovered from bus-off
0x8210	PDO have not be dealt with because of length error
0x8220	Too long
0x9000	External error

Form 9 error code

4 Description of LED indicate light

We suggest two indicator lighter will be supported: one is red (ERR LED),the other id green (RUN LED).we can differentiate the following state by indicator's state and flashing frequency:

States	Description
ON	The LED shall be constantly on.
OFF	The LED shall be constantly off.
Flickering	Shall indicate the iso-phase on and off with a frequency of approximately 10Hz:on for approximately 50ms and off for approximately 50ms
Flickering	Shall indicate the iso-phase on and off with a frequency of approximately 2.5Hz:on for approximately 200ms followed off for approximately 200ms.
Single flash	Shall indicate one short flash (approximately 200ms) follows by a long off phase (approximately 1000ms).
Double flash	Shall indicate a sequence of two short flashes (approximately 200ms),separated by an off phase (approximately 200ms).The sequence is finished by a long off phase (approximately 1000ms).
Triple flash	Shall indicate a sequence of three short flashes (approximately 200ms),separated by an off phase (approximately 200ms).The sequence is finished by a long off phase (approximately 1000ms).

Form 10 state of indictor light

CANopen Error LED

The error LED of CANopen indicates the CAN physical layer's condition, and indicate the error that caused the missing of CAN message(SYNG,GUARD,Heartbeat).it is the red LED.

numbers	ERROR LED	state	descriptions
1	OFF	No error	Device is in working status.

2	Single flash	Warning limit reached	At least one of the error counters of the CAN controller has reached or exceeded the warning level (too many error frames)
3	Flickering	AutoBitrate / LSS	The auto-bitrate detection is in progress or LSS services are in progress(alternately flickering with run LED).
4	Double flash	Error control events	A guard event (NMT-slave or NMT-master) or a heartbeat event (heartbeat consumer) has occurred.
5	Tripple flash	Sync error	The sync message has not been received within the configured communication cycle period time out(see object dictionary entry 1006H)
6	ON	BUS-off	CAN controller is bus off.

Form 10 Status of error LED

CANopen Run LED

CANopen runs the state that LED indicate CANopen network state institutions, it is the green LED

Number	RUN LED	status	descriptions
1	Flickering	AutoBitrate / LSS	The auto-bitrate detection is in progress or LSS services are in progress (alternately flickering with error LED)
2	Single flash	STOPPED	The device is in state STOPPED
3	Blinking	PRE-OPERATIONAL	The device is in the state PRE-OPERATIONA
4	ON	OPERATIONAL	The device is in state OPERATIONAL

Form 12 States of RUN LED

5 Digital IO module

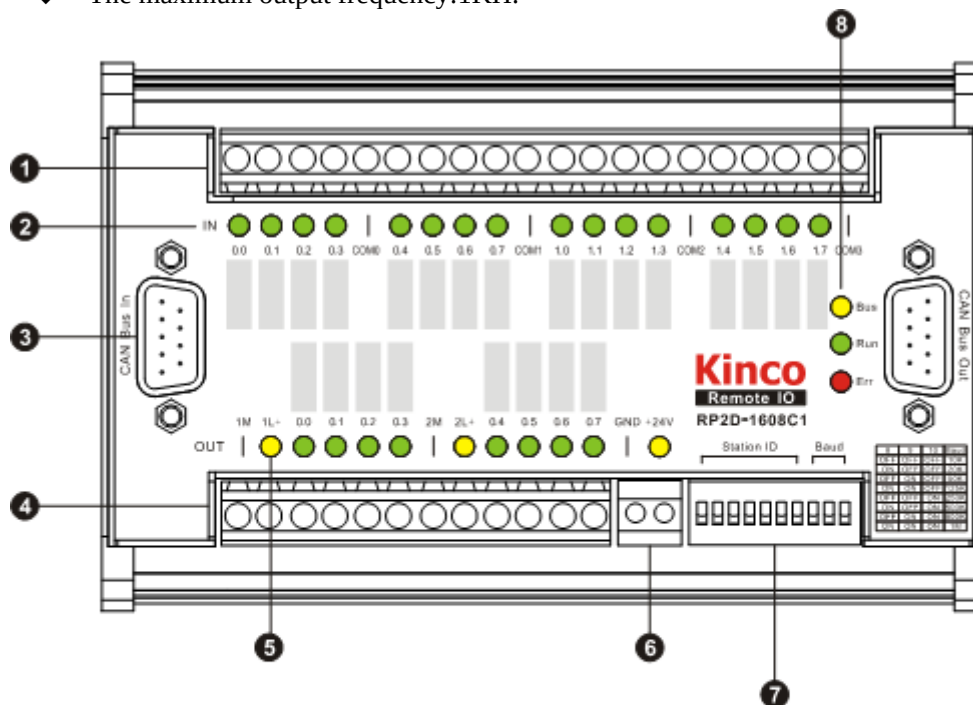
5.1 RP2D-1608C1, 16DI + 8DO DC 24V

The characteristics of DI channel

- ◆ Signal on site and internal signal is isolated by Photoelectric coupling technique
- ◆ A group of four channels use one common terminal, two common terminals are isolated from each other.
- ◆ A group of four channels can use both NPN and PNP input.
- ◆ The range of input level : 12~24VDC,input current>4mA
- ◆ Response time of input:10ms
- ◆ Each channel has its independent state indicator

The characteristics of DO channel:

- ◆ Signal on site and internal signal are isolated by Photoelectric coupling technique.
- ◆ The rated voltage supply is 24V DC.
- ◆ Each group has four channels outputs.
- ◆ The rated output current of each channel is 500mA.
- ◆ The maximum output frequency:1KH.



- | | |
|-----------------------------|---------------------------------------|
| ① — Digital input terminal | ⑤ — Power indicator |
| ② — States indicator of I/O | ⑥ — System power |
| ③ — Communication port(CAN) | ⑦ — Baud rate and station No. setting |
| ④ — Digital output terminal | ⑧ — States indicator of CPU |

Chart 3 RP2D-1608C1

Wiring diagram

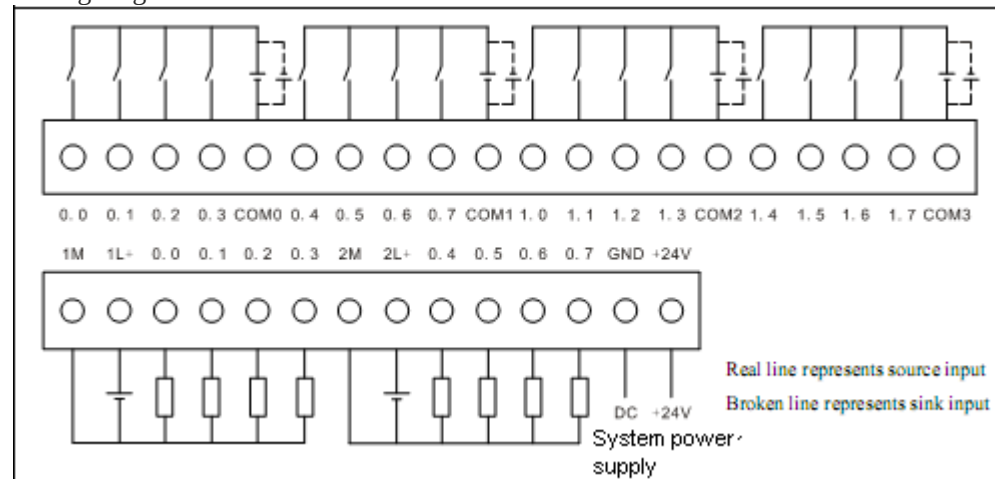


Chart 5 Wiring diagram of RP2D-0016C1

Object dictionary:

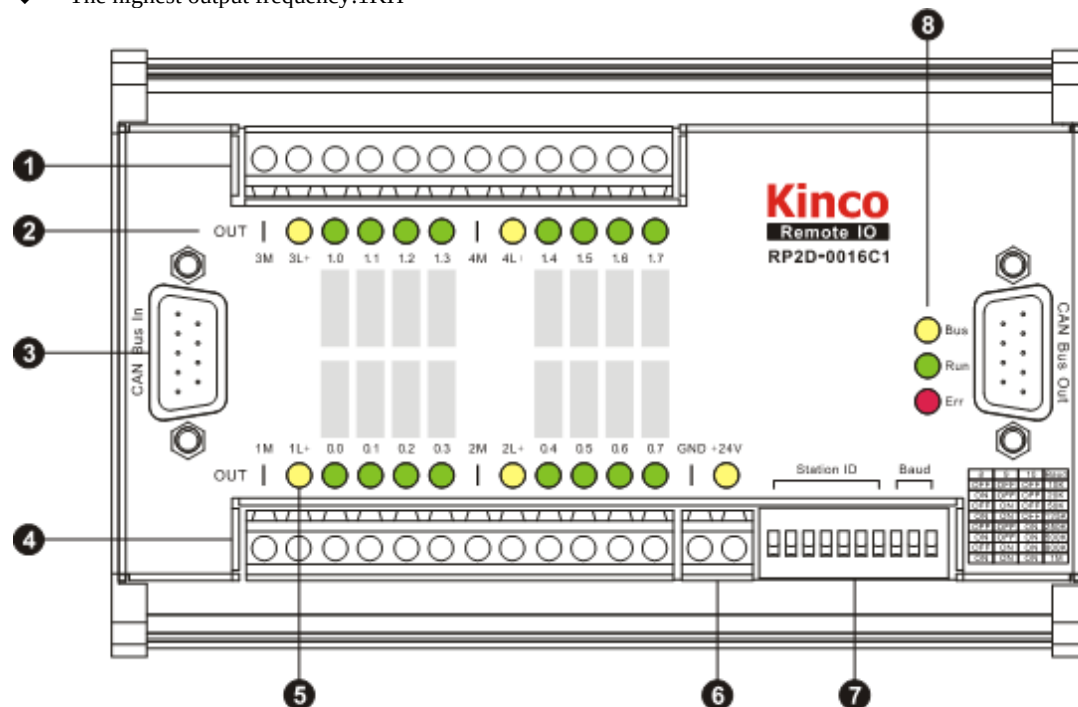
Object Dictionary				
index	Object	Name	Data type	Object is mappable
1000H	Var	Device type number	Unsigned32	FALSE
1001H	Var	Error Register	Unsigned8	TRUE
1005H	Var	Identifier SYNC-Message	Unsigned32	FALSE
1008H	Var	Device description	String	FALSE
1009H	Var	Hardware Version	String	FALSE
100AH	Var	Software Version	String	FALSE
100CH	Var	Guard Time	Unsigned16	FALSE
100DH	Var	Life Time Factor	Unsigned8	FALSE
1014H	Var	Identifier Emergency	Unsigned32	FALSE
1016H	Array	Consumer Heartbeat Time	Unsigned32	FALSE
1017H	Var	Producer Heartbeat Time	Unsigned16	FALSE
1018H	Record	Identity Object	Identity	FALSE
1029H	Array	Error Behavior	Unsigned8	FALSE
1200H	Record	1st Server SDO Parameter	SDO Parameter	FALSE
1400H	Record	RPDO1 Communication parameter	PDOComPar	FALSE
1401H	Record	RPDO2 Communication parameter	PDOComPar	FALSE
1600H	Record	RPDO1 Mapping parameter	PDOMapPar	FALSE
1601H	Record	RPDO2 Mapping parameter	PDOMapPar	FALSE
1A01H	Record	TPDO2 Mapping parameter	PDOMapPar	FALSE
6200H	Array	Write Output 8Bit	Unsigned8	FALSE
6206H	Array	Error Mode Output 8Bit	Unsigned8	FALSE
6207H	Array	Error Value Output 8Bit	Unsigned8	FALSE

Form 13 Object dictionary of Wiring diagram of RP2D-1608C1

5.2 RP2D-0016C1, 16DO DC 24V

The characteristics of the DI channel

- ◆ The input signal and internal signal is isolated by Photoelectric coupling technique
- ◆ The rated voltage supply is 24V DC
- ◆ Each group has four routs output
- ◆ The rated output current of each rout is 500mA
- ◆ The highest output frequency:1KH



- | | |
|-----------------------------|---------------------------------------|
| ① — Digital output terminal | ⑤ — Power indicator |
| ② — States indicator of I/O | ⑥ — System power |
| ③ — Communication port(CAN) | ⑦ — Baud rate and station No. setting |
| ④ — Digital output terminal | ⑧ — States indicator of CPU |

Chart4 RP2D-0016C1

Wiring diagram

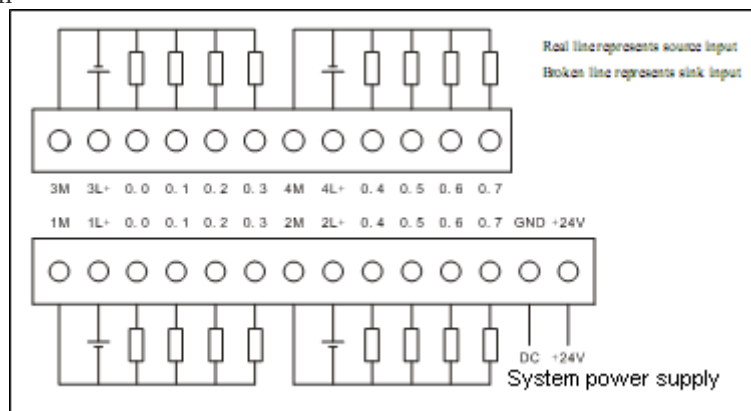


Chart 5 Wiring diagram of RP2D-0016C1

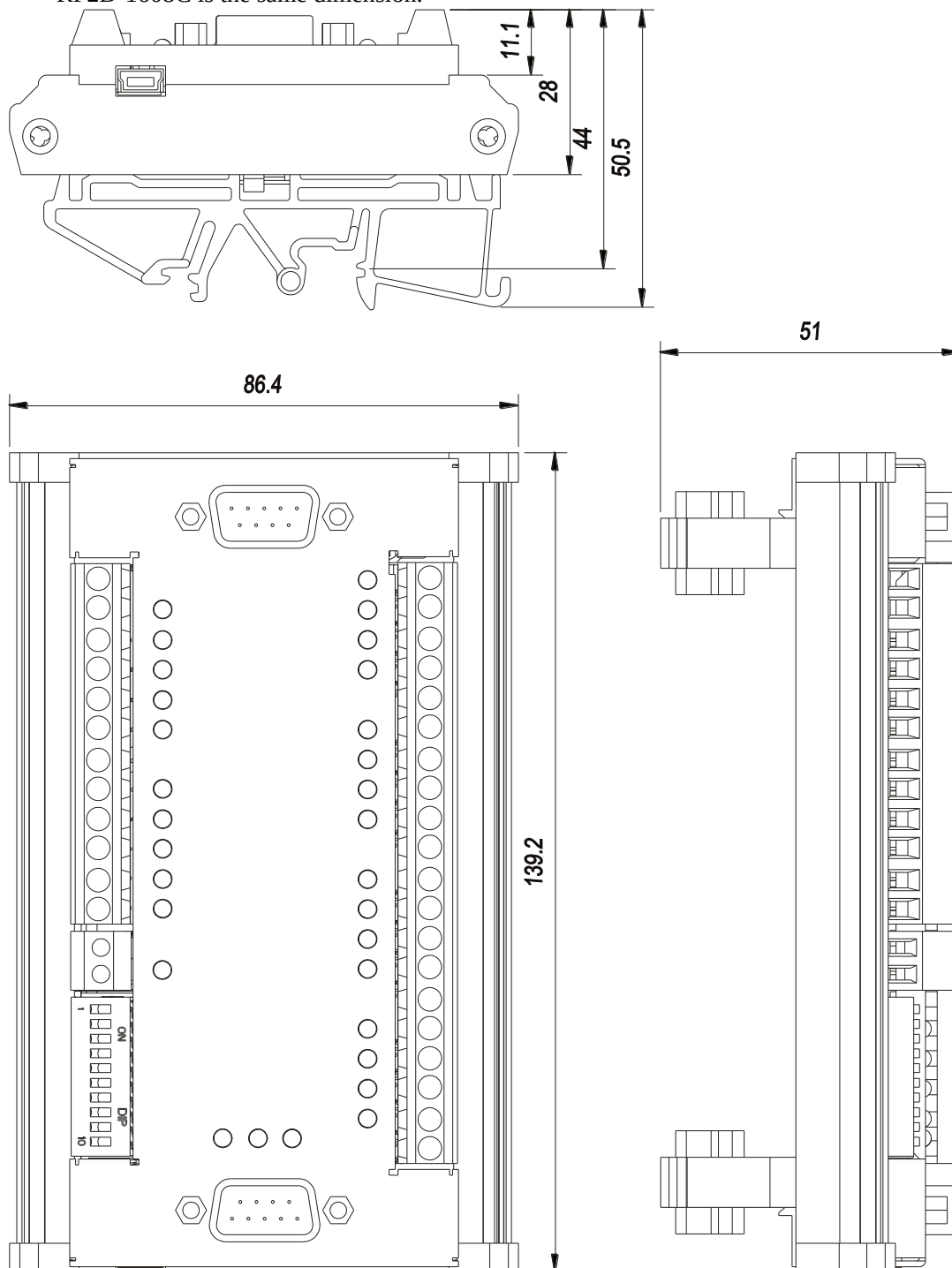
Object dictionary

Object Dictionary				
index	Object	Name	Data type	Object is mappable
1000H	Var	Device type number	Unsigned32	FALSE
1001H	Var	Error Register	Unsigned8	TRUE
1005H	Var	Identifier SYNC-Message	Unsigned32	FALSE
1008H	Var	Device description	String	FALSE
1009H	Var	Hardware Version	String	FALSE
100AH	Var	Software Version	String	FALSE
100CH	Var	Guard Time	Unsigned16	FALSE
100DH	Var	Life Time Factor	Unsigned8	FALSE
1014H	Var	Identifier Emergency	Unsigned32	FALSE
1016H	Array	Consumer Heartbeat Time	Unsigned32	FALSE
1017H	Var	Producer Heartbeat Time	Unsigned16	FALSE
1018H	Record	Identity Object	Identity	FALSE
1029H	Array	Error Behavior	Unsigned8	FALSE
1200H	Record	1st Server SDO Parameter	SDO Parameter	FALSE
1400H	Record	RPDO1 Communication parameter	PDOComPar	FALSE
1401H	Record	RPDO2 Communication parameter	PDOComPar	FALSE
1600H	Record	RPDO1 Mapping parameter	PDOMapPar	FALSE
1601H	Record	RPDO2 Mapping parameter	PDOMapPar	FALSE
1A01H	Record	TPDO2 Mapping parameter	PDOMapPar	FALSE
6200H	Array	Write Output 8Bit	Unsigned8	FALSE
6206H	Array	Error Mode Output 8Bit	Unsigned8	FALSE
6207H	Array	Error Value Output 8Bit	Unsigned8	FALSE

Form 14 Object dictionary of RP2D-0016C1

6 Installation dimension:

- ◆ Please observe the installation direction of I/O terminal, or it may cause failure.
- ◆ There should be prescriptive space between IO terminal and cabinet or other machines , or it may cause failure.
- ◆ The Installation dimension of RP2D-1608C as the following chart , RP2D-0016C1 and RP2D-1608C is the same dimension.



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